Price, Yield and Rate Calculations for a Treasury Bill

These examples are provided for illustrative purposes only and are in no way a prediction of interest rates or prices on any bills, notes or bonds issued by the Treasury.

In order for the reader to follow the step-by-step calculations, these examples were prepared on an Excel spreadsheet using 15 decimals, with rounding at each step. For readers who use multi-decimal calculators, we recommend setting the calculator to its maximum decimal settings and then applying normal rounding procedures.

In actual practice, Treasury uses a mainframe and generally does not round prior to determining the final result. In the case of any discrepancies due to rounding, determinations by the Treasury shall be final.

Calculate the Dollar Price for a Treasury Bill

Description: T-Bill 02/19/2004

Variables / Inputs

Issue Date:		01/22/2004	
Maturity Date:		02/19/2004	
Discount Rate:	d	0.800%	
Days to Maturity:	r	28	Jan. 22, 2004 to Feb. 19, 2004
Days in Year:	y	366	Jan. 22, 2004 to Jan. 22, 2005

Formula

P = 100 (1 - dr / 360)

(1) P = 100 * (1 - (0.0080 * 28) / 360)
(2) P = 100 * (1 - 0.000622222222222)
(3) P = 100 * (0.999377777777778)
(4) P = 99.937778 Rounded to 6 places

Convert Price to Discount Rate

Equation

$$d = \left[\frac{100 - P}{100} * \frac{360}{r} \right] \quad ====> \quad d = \left[\frac{100 - 99.937778}{100} * \frac{360}{28} \right]$$

Formula

d = ((100 - P) / 100) * (360 / r)

(1) d = ((100 - 99.937778) / 100) * (360 / 28)
(2) d = (0.062222000000006 / 100) * 12.857142857142857
(3) d = 0.000622220000000 * 12.857142857142857
(4) d = 0.007999971428571
(5) d = 0.800%

Calculate Coupon Equivalent Yield
For bills of not more than one half-year to maturity

Equation

$$i = \left[\frac{100 - P}{P} * \frac{y}{r} \right] \quad ====> \quad i = \left[\frac{100 - 99.937778}{99.937778} * \frac{366}{28} \right]$$

Formula

i = ((100 - P) / P) * (y / r)

(1) i = ((100 - 99.937778) / 99.937778) * (366 / 28)
(2) i = (0.062222000000006 / 99.937778) * 13.071428571428571
(3) i = (0.000622607398776 * 13.071428571428571)
(4) i = 0.008138368141143
(5) i = 0.814%

Calculate Coupon Equivalent Yield
For bills of more than one half-year to maturity

The basic formula is:
P [1 + (r - y / 2) (i / y)] (1 + i / 2) = 100

Which can be expressed the quadratic form of: $ax^2 + bx + c = 0$
i^2 [r / 2y - .25] + i (r / y) + ((P - 100) / P) = 0

In order to calculate the Coupon Equivalent Yield on a Treasury Bill you must first solve for the intermediate variables in the equation. In this formula they are addressed as: *a* , *b* , and *c.*

Variables / Inputs

Issue Date:		06/07/1990	
Maturity Date:		06/06/1991	
Discount Rate:	d	7.65%	
Price:	P	92.265000	
Days to Maturity:	r	364	(Jun. 07, 1990 to Jun. 06, 1991)
Days in Year:	y	365	(Jun. 07, 1990 to Jun. 07, 1991)

Formulas to be used

$$i = \frac{-b + \sqrt{(b^2 - 4ac)}}{2a}$$

b = r / y
a = (r / 2y) - 0.25
c = (P - 100) / P

Begin by Solving for *a*

a = (r / 2y) - 0.25

(1) a = (364 / (2 * 365)) - 0.25
(2) a = (364 **/** 730) - 0.25
(3) a = 0.498630136986301 - 0.25
(4) a = 0.248630136986301

Next Solve for *b*

b = r / y

(1) b = 364 / 365

(2) b = 0.997260273972603

Next Solve for *c*

c = (P - 100) / P

(1) c = (92.265000 - 100) / 92.265000

(2) c = -7.735 / 92.265000

(3) c = -0.083834606838996

Using the above calculated variables solve for the Investment Rate using the following formula.
Begin by populating the equation with the variables and then solving for Part A, Part B, and Part C.

Solve for i

$$i = \frac{- b + \sqrt{(b^2 - 4ac)}}{2a}$$

$$(1)\ i = \frac{-0.997260273972603 + \sqrt{0.997260273972603^2 - (4 * 0.248630136986301 * -0.083834606838996)}}{2 * 0.248630136986301}$$

$$(2)\ i = \frac{-0.997260273972603 + \sqrt{0.994528054043911 - -0.083375239130289}}{0.497260273972602}$$

$$(3)\ i = \frac{-0.997260273972603 + \sqrt{1.077903293174200}}{0.497260273972602}$$

$$(4)\ i = \frac{-0.997260273972603 + 1.038221215914123}{0.497260273972602}$$

$$(5)\ i = \frac{0.040960941941520}{0.497260273972602}$$

(6) i = 0.082373244124820

(7) i = 8.237%

Sample Settlement Information

If the 6-decimal price per hundred is 99.937778, then:

Face Amount	1,000,000.00	100,000,000.00	1,000,000,000.00
Settlement Amount	999,377.78	99,937,778.00	999,377,780.00